MANAGEMENT OBJECTIVES

Goal 1. Protect or improve the aquatic foodbase so that it will support viable populations of desired species at higher trophic levels.

MO #	Perform some action	On some element	On some attribute	At some place	From the current level	To the target level	Comments
The target for all the Management Objectives in Goal 1 is adequate food availability to support trout and native fish above the Paria River and native fish below the Paria River. Linkages: See the number of fish desired under Goals 2, 3, and 4.							
1.1	Maintain or attain	Primary producers: algae on hard substrates, rooted macrophytes on soft substrates, and diatoms	Biomass	Mainstem from Glen Canyon Dam to the Paria River in both pools and on cobble bars identified by specific sampling sites	$x \pm y$ g/m^2 (cobble)[0] $a \pm b$ g/m^2 (pool) (To be provided from Shannon.)	$x \pm y$ g/m^2 (cobble) $a \pm b$ g/m^2 (pool) (Need to resolve differences between data from Shannon et al. and AGFD.)	See McKinney et al. 1999[22] The small group suggested the target should be the average of 1996 and 1997 data which they believe represents the best biomass estimates for the period in which data are available, and because they appeared to be good years to support the desired species.
			Composition		River Mile / % Algae / % Macrophytes Pools IN / IN IN / IN IN / IN Cobbles IN / IN IN / IN IN / IN	Information Need	Given the change in composition, the idea of Cladophora as a keystone species has been called into question. Scientists have said composition is an Information Need and should not be broken down below algae and macrophytes at this point in time.
1.2	Maintain or attain	Benthic invertebrates	Biomass	Mainstem from Glen Canyon	$x \pm y$ g/m^2 (cobble) $a \pm$- b g/m^2 (pool)	$x \pm y$ g/m^2 (cobble) $a \pm b$ g/m^2 (pool)	See McKinney *et al.* 1999[22]

MANAGEMENT OBJECTIVES

Goal 1. Protect or improve the aquatic foodbase so that it will support viable populations of desired species at higher trophic levels.

MO #	Perform some action	On some element	On some attribute	At some place	From the current level	To the target level	Comments

The target for all the Management Objectives in Goal 1 is adequate food availability to support trout and native fish above the Paria River and native fish below the Paria River.
Linkages: See the number of fish desired under Goals 2, 3, and 4.

			Composition	Dam to Paria River	Cobble: __ % Tubificids __ % *Gammarus* __ % Chironomids __ % Gastropods __ % Other Pool: __ % Tubificids __ % *Gammarus* __ % Chironomids __ % Gastropods __ % Other (per Shannon and AGFD.)	Information Need	Metric is relative % of species.
1.3	Maintain or attain	Primary producers: algae on hard substrates, rooted macrophytes on soft substrates, and diatoms	Biomass	Mainstem below the Paria River on cobble bars identified by specific sampling sites	River Mile / g/m^2 Cobble 2 61 68 127 205	50 $g/m^{2(27)}$	
			Composition		River Mile / % Algae / % Macro-phytes Pools 2 61 68 127 205 Cobble 2 61 68 127 205	Information Need	Metric is relative % of algal species. MAMB is for miscellaneous algae, macrophytes, and bryophytes

MANAGEMENT OBJECTIVES

Goal 1. Protect or improve the aquatic foodbase so that it will support viable populations of desired species at higher trophic levels.

MO #	Perform some action	On some element	On some attribute	At some place	From the current level	To the target level	Comments
1.4	Maintain or attain	Benthic invertebrates	Biomass	Mainstem below the Paria River	0.960 g/m^2 (cobble)[27] 0.054 g/m^2 (pool)[27]	To be provided based on 1996-97 data.	
			Composition		Cobble: __ % Tubificids __ % *Gammarus* __ % Chironomids __ % Gastropods __ % Other Pool: __ % Tubificids __ % *Gammarus* __ % Chironomids __ % Gastropods __ % Other	Obtain from literature	Metric is relative % of species.
1.5	Maintain or attain	Foodbase drift: Diptera *Gammarus* Other Bugs CPOM FPOM DOC	Abundance	Mainstem below GCD	River Mile / AFDW: 2 61 68 127 205	To be provided based on 1996-1997 data	

Goal 2. Maintain or attain viable populations of existing native fish, remove jeopardy from humpback chub and razorback sucker, and prevent adverse modification to their critical habitat.

MO #	Perform some action	On some element	On some attribute	At some place	From the current level	To the target level	Comments
2.1	Maintain or attain	Humpback chub (150 mm and larger) (Length is based on the size at which a HBC is able to be pit-tagged.)	Abundance	LCR aggregation (The definition of the LCR aggregation will be resolved following completion of the stock assessment workshop and the PEP review.)	4330-4811 individuals[3] with a mean of 4508 individuals	Information Need	The target is viable populations and removal of jeopardy. Target to be based on 91-96 population estimate, PVA, & N_e.
				Eight mainstem aggregations	Information Need Confidence interval with a mean of 225 individuals?	Information Need	
2.2	Maintain or attain	Humpback chub (51 mm to 150 mm)	Year class strength	LCR aggregation	Information Need. Consider using a CPUE index for different year classes, at some place in the LCR at some time during the year.	Information Need. Intended to be an index that will indicate spawning success.	The target is viable populations and removal of jeopardy. Metric is catch per unit effort (CPUE). See Gorman and Bramblett.[9] See synthesis by Coggins.
				Eight mainstem aggregations	Information Need	Information Need	
2.3	Maintain or attain	Humpback chub (> 200 mm) (This is the length at which 50% of the fish are thought to be sexually mature.)	Recruitment	LCR aggregation	Information Need	Information Need	The target is viable populations and removal of jeopardy.
				8 mainstem aggregations	Information Need	Information Need	
2.4	Establish	Humpback chub	Spawning aggregation	CRE below GCD	One spawning aggregation in the LCR	A second spawning aggregation	The target is removal of jeopardy.
2.5	Attain	Humpback chub	Condition	LCR aggregation	Information Need	Information Need. There should be a minimum threshold.	The target is viable populations and removal of jeopardy. PEP should be asked to evaluate the method that would be used to calculate condition and
				8 mainstem aggregations	Information Need	Information Need	
			Disease and other	LCR aggregation	Information Need	Information Need	

Goal 2. Maintain or attain viable populations of existing native fish, remove jeopardy from humpback chub and razorback sucker, and prevent adverse modification to their critical habitat.

MO #	Perform some action	On some element	On some attribute	At some place	From the current level	To the target level	Comments
			parasites	8 mainstem aggregations	Information Need	Information Need	the value to be established as the threshold.
2.6	Reduce	Native fish	Mortality due to non-native fish predation as a % of overall mortality	LCR	Information Need	Information Need	The target is reduction of non-native fish predation so it does not impinge on native fish viability. Linkages: The native fish MOs in Goal 2 and Goal 3.
				Mainstem	Information Need	Information Need	
2.7	Attain	Razorback sucker	Abundance	CRE below GCD	0 individuals[9]	Information Need	The target is derived from the capability of the habitat to support the species, and includes the removal of jeopardy.
2.8	Maintain	Flannelmouth sucker	Abundance	CRE below GCD	AGFD to provide [9]	Information Need	Appropriate metric to be determined. The target is viable populations.
			Distribution		AGFD to provide [9]	Information Need	
		Bluehead sucker	Abundance		AGFD to provide [9]	Information Need	
			Distribution		AGFD to provide [9]	Information Need	
		Speckled dace	Abundance		AGFD to provide [9]	Information Need	
			Distribution		AGFD to provide [9]	Information Need	

Goal 3. Restore populations of extirpated species, as feasible and advisable.

MO #	Perform some action	On some element	On some attribute	At some place	From the current level	To the target level	Comments
3.1	Restore	Colorado pikeminnow	Abundance	CRE downstream of GCD	0 individuals[9]	Information Need	
		Bonytail			0 individuals[9]	Information Need	
		Roundtail Chub			0 individuals[9]	Information Need	
		River otter			0 individuals[10]	Information Need	

Goal 4. Maintain a naturally reproducing population of rainbow trout above the Paria River, to the extent practicable and consistent with the maintenance of viable populations of native fish.

MO #	Perform some action	On some element	On some attribute	At some place	From the current level	To the target level	Comments
Linkages: See Issue Paper B (trout).							
4.1	Maintain or attain	Rainbow trout (RBT)	Abundance	Mainstem from Glen Canyon Dam to Paria River	260,000 ± 30,000 Age II+ individuals[23]	100,000 Age II+ individuals	The target is adequate abundance of wild-reproducing Rainbow trout to maintain a quality recreational fishery, while not adversely affecting native fish population viability.
					Electrofishing CPUE	Information Need	
			Proportional stock density (see below)		15%	Information Need	Might replace measure of "length at age" in the future. Value of metric needs to be assessed.
			Length at age		15" by Age III[23]	15 – 18" by Age III	
			Condition		$W_r = 0.82$[23]	$W_r = 0.90$	
			Whirling disease and other parasitic infections		Absence	Absence	
			Spawning habitat		Information Need	Information Need	Metric is quality and abundance of habitat.
			Natural recruitment		100%	100%	This MO restates and measures the goal.
4.2	Limit	Lees Ferry RBT	Distribution	CRE below the Paria River	Information Need	Information Need. Need research and data that demonstrate predator-prey and competitive effect.	The target is minimal competitive or predator-prey effect on downstream native fish.

Proportional Stock Density is the ratio that results by dividing the number of fish great than 16 inches by the number of all fish greater than 12 inches. This provides a measure of the abundance of fish at a certain size, which should translate into a target for both abundance and length at age.

Goal 5. Maintain or attain viable populations of Kanab ambersnail.

MO #	Perform some action	On some element	On some attribute	At some place	From the current level	To the target level	Comments
5.1	Attain and maintain	Kanab ambersnail	Population	Vasey's Paradise	7100 (April 1999) 6400 (May 1999) 20,000 (July 1999) 35,000 (Sept/Oct 1999) (Individuals below 70,000 cfs stage)[24]	Information Need (to be measured in the spring and before any Management Action that may affect the population)	The metric is the population parameter(s) that indicate viability. The target is a viable population. "Viable" includes the entire population, not just those below 70,000 cfs. Management Action: monitor the KAS populations at Keyhole, Elves, and Deer Creek
5.2	Maintain	Kanab ambersnail	Habitat	Vasey's Paradise	82-99 m^2 monkeyflower and 36.6 m^2 watercress below 70,000 cfs stage. Information Need (for above new stage level when it is determined)	Information Need. An x-year running average greater than or equal to y% of the total area of occupied habitat measured at Vasey's in March 1996, with a minimal level TBD.	The target is the level needed to sustain a viable population. Purpose is to limit human impact, by intentional flooding or other actions, to habitats occupied by Kanab ambersnail.

Goal 6. Protect or improve the biotic riparian and spring communities, including threatened and endangered species and their critical habitat.

MO #	Perform some action	On some element	On some attribute	At some place	From the current level	To the target level	Comments
The target is an achievable and appropriate mix of four types of communities: marsh, open sand beach, old high water zone (OHWZ), and new high water zone (NHWZ). All four communities are important for maintaining the diversity of wildlife, visitor use, and cultural resources. See the Riparian Issue Paper for more information.							
6.1	Maintain	Marsh community	Abundance	CRE below GCD, and above Lake Mead's water level as it fluctuates due to Hoover Dam operations	1215 patches (4.6 ha)[7]	For an x-year running average of y or more marsh patches >/= 10 m^2, as determined by standard criteria for wetland species, soil type, and wetted area.	See Kearsley[15] and Stevens *et al.* [29].
			Composition		Information Need	No loss of native species. Species are assumed still to be present when they have been detected by monitoring within the last 10 years.	
			Area		Information Need	For an x-year running average area equal to ± y% of the area defined by aerial imaging in 2000.	
6.2	Maintain	New high water zone community	Patch number and distribution	CRE below GCD, and above Lake Mead's water level as it fluctuates due to Hoover Dam operations	Information Need	Information Need	The target is to allow for scouring of NHWZ vegetation to 1984 levels for patch number and distribution, and then allow its return through successional processes
			Composition		Information Need	Species are assumed still to be present when they have been detected by monitoring within the last 10 years.	The target is to allow no loss of native plant or animal species.
			Area		Information Need	For an x-year running average area equal to ±- y% of the area defined by aerial imaging in 2000.	NHWZ vegetation & sand beaches occur in the same strip of land. An increase to NHWZ vegetation will reduce the amount of open sand, and vice versa. These objectives are therefore closely linked to each other, as well as to the beach-building effects of BHBFs.

Goal 6. Protect or improve the biotic riparian and spring communities, including threatened and endangered species and their critical habitat.

MO #	Perform some action	On some element	On some attribute	At some place	From the current level	To the target level	Comments
6.3	Maintain	Old high water zone community	Abundance	CRE below GCD, and above Lake Mead's water level as it fluctuates due to Hoover Dam operations	In 1992, there was an estimated 1,870 acres of OHWZ vegetation (Stevens 1992).	Information Need	The target is no significant loss of area.
			Composition		Information Need	Information Need	The target is no loss of native plant or animal species.
			Distribution		Information Need	Information Need	
6.4	Maintain	Sand Beach community	Abundance	CRE below GCD, and above Lake Mead's water level as it fluctuates due to Hoover Dam operations	Information Need	Information Need	See Kearsley [15] and Stevens *et al.* [29]
			Composition		Information Need	Information Need	
			Distribution		Information Need	Information Need	
6.5	Reduce	Invasive non-native species	Abundance (Abundance refers to number of individuals within the species. These species should be limited to invasive ones, not just non-natives.)	CRE below GCD, and above Lake Mead's water level as it fluctuates due to Hoover Dam operations	95+ species (plants)[28] 3 species (birds)[28]	No new non-native species. Invasive non-native species cover </= x% of total riparian area. The targets are species-specific. (Information Need)	The target for abundance is the level at which these species do not impinge on biological, recreational, and cultural resources.
			Distribution		Information Need	Information Need	The target for distribution is no spreading of invasive non-native species to areas where they do not already occur.

Goal 6. Protect or improve the biotic riparian and spring communities, including threatened and endangered species and their critical habitat.

MO #	Perform some action	On some element	On some attribute	At some place	From the current level	To the target level	Comments
6.6	Maintain	Spring and wetland	Habitat occupied by rare and endemic species	CRE below GCD, and above Lake Mead's water level as it fluctuates due to Hoover Dam operations	Information Need	Information Need	The target is to maintain the capability of these habitats to support the rare and endemic species known to live there. The targets should recognize the dynamic nature of these habitats as influenced by flow events.
6.7	Maintain	Southwest willow flycatcher	Riparian habitat	CRE below GCD, and above Lake Mead's water level as it fluctuates due to Hoover Dam operations	Information Need	Information Need	The target is the capability of the habitat to support the species. The target is a dynamic mosaic of NHWZ, OHWZ, and marsh vegetation. The definition of critical habitat will change as we learn more about the species' needs.

Goal 7. Establish water temperature, quality, and flow dynamics to achieve GCDAMP ecosystem goals.

MO #	Perform some action	On some element	On some attribute	At some place	From the current level	To the target level	Comments
7.1	Attain	Water	Temperature range	Mainstem	6.93-18.56 °C[17]	Information Need	The target may include several stations in the mainstem.
			Seasonal variability of temperature		Information Need	Information Need	
The target for MO 7.1 is a temperature range and pattern of seasonal variability based on the range of natural variability, the physical capacity of the dam, and the range that optimizes conditions for the targeted resources. Targeted resources may include foodbase, native fish, trout, and people (human health and safety – microorganisms and hypothermia). Temperature patterns should have as their first priority the improvement of conditions for native biological resources, including native fish, and including foodbase and trout interactions. This is based on the special status of native fish. Linkages: MO 13; Principles 4, 6, and 7; and the Vision-Mission statement.							
7.2	Maintain	Water	Quality	Mainstem	Information Need (for the specific water quality parameters to use).	Information Need	Parameters may include nutrients, salinity, pH, DO, nitrogen, phosphorus, microbes, and others. Data available from NASQWAN.[35]
The target for MO 7.2 is water quality based on the range of natural variability, the physical capacity of the dam, the legally defined state water quality standards, and the range that optimizes conditions for the targeted resources. The targeted resources may include foodbase, native fish, trout, Southwestern willow flycatcher, riparian and spring communities, the recreational experience, and cultural resources. Linkages: Goals 1-3, 8-10, and 12.							
7.3	Maintain	Flow dynamics	Power plant operations	Mainstem	ROD operating criteria	Dam operating criteria then in effect	See MO 50 for experimental flows.
			BHBF flows		Maximum 45,000 cfs (March to April)	Dam operating criteria then in effect	
			Habitat maintenance flows		ROD operating criteria	Dam operating criteria then in effect	

Goal 8. Maintain or attain levels of sediment storage within the main channel and along shorelines to achieve GCDAMP ecosystem goals.

MO #	Perform some action	On some element	On some attribute	At some place	From the current level	To the target level	Comments
The target for Goal 8 is enough sediment to achieve the biological, recreational, and cultural goals. Given limited sediment inputs, we need to retain enough sediment in the system to achieve ecosystem patterns in these goals). For the biological goals, the purposes are habitat and nutrient storage. For the cultural goal, the purposes are enhancing plant habitat and preserving historical properties. For recreational goals, the purposes are camping beaches and trout spawning habitat. Linkages: Recreational, biological, and cultural goals: 1-4, 7-10, and 12.							
8.1	Maintain or attain	Sediment	Abundance	Main channel below 5,000 cfs	Information Need	Current volumes or higher (trend), including some timeframe based on tributary inputs and high flows timing (Information Need).	Metric is volume (m^3) as a rolling average.
			Grain-size		Information Need	Current level or finer (trend), including some timeframe based on reach, tributary inputs and high flows timing (Information Need).	Metric is D50 (median) grain size. Also, see Kondolf.[16]
			Distribution		Information Need Current level to be obtained from side scan sonar and video (Anima) and/or multi-beam.	Current level or more areally extensive (trend), including some timeframe based on tributary inputs and high flows timing (Information Need).	Metric is patchiness and area (m^2) of sand on channel bottom.
8.2	Maintain or attain	Sediment	Abundance	Channel margins (not eddies) from 5,000 to 25,000 cfs	Information Need	Information Need, including some timeframe based on tributary inputs and high flows timing.	Metric is area (m^2) and volume (m^3) as a rolling average.
			Grain-size		Information Need	Information Need, including some timeframe based on tributary inputs and high flows timing.	See Kondolf.
			Distribution		Information Need	Information Need, including some timeframe based on tributary inputs and high flows timing.	Metric is number of sandbars by reach.

Goal 8. Maintain or attain levels of sediment storage within the main channel and along shorelines to achieve GCDAMP ecosystem goals.

MO #	Perform some action	On some element	On some attribute	At some place	From the current level	To the target level	Comments
8.3	Maintain or attain	Sediment	Abundance	Eddies below 5,000 cfs	Information Need	Information Need, including some timeframe based on tributary inputs and high flows timing.	Metric is area (m^2) and volume (m^3) as a rolling average
			Grain-size		Information Need	Information Need, including some timeframe based on tributary inputs and high flows timing	
			Distribution		Information Need	Information Need, including some timeframe based on tributary inputs and high flows timing.	Metric is # of sandbars by reach
8.4	Maintain or attain	Sediment	Abundance	Eddies between 5,000 and 25,000 cfs	Information Need	Information Need, including some timeframe based on tributary inputs and high flows timing.	Metric is area (m^2) and volume (m^3) as a rolling average The target level should consider spawning habitat for trout in Glen Canyon and sediment needed for BHBFs.
			Grain-size		Information Need	Information Need, including some timeframe based on tributary inputs and high flows timing	The target level should consider spawning habitat for trout in Glen Canyon and sediment needed for BHBFs.
			Distribution		Information Need	Information Need, including some timeframe based on tributary inputs and high flows timing.	Metric is number of sandbars by reach The target level should consider spawning habitat for trout in Glen Canyon and sediment needed for BHBFs.

Goal 8. Maintain or attain levels of sediment storage within the main channel and along shorelines to achieve GCDAMP ecosystem goals.

MO #	Perform some action	On some element	On some attribute	At some place	From the current level	To the target level	Comments
8.5*	Maintain or attain	Sediment	Abundance	Shorelines above 25,000 cfs	Information Need	Information Need	Metric is area (m^2) and volume (m^3) as a rolling average
			Grain-size		Information Need	Information Need	
			Distribution		Information Need	Information Need	Metric is number of sandbars by reach

*This Management Objective is intended to include all shorelines (eddies and channel margins) between 25,000 cfs and the highest level of potential dam effects on pre-dam sand bars (about 125,000 cfs or pre-dam alluvium (pda) terrace of Hereford *et al*. 1998). The highest level will be determined through discussions with sedimentological, cultural, recreational, and riparian workers on how best to constrain this boundary and in how many areas it should be monitored.

NOTE: Coarse sediment is important to the ecosystem, as is fine sediment. There is a Management Objective on rapids navigability under the recreation goal that indirectly addresses debris flows, as well as an MO on trout spawning habitat under the trout goal.

Information Need: consult with various researchers to determine how best to break out sub-reaches from the three broader fine sediment reaches as described above. The riparian group suggested developing a table that has various resource concerns on the *X*-axis and various processes on the *Y*-axis. The recreation group suggested developing a table that has river miles (-15 to 278) on the *X*-axis and various resources on the *Y*-axis (those resource areas impacted by sedimentological processes).

Goal 9. Maintain or improve the quality of recreational experiences for users of the Colorado River ecosystem, within the framework of GCDAMP ecosystem goals.

MO #	Perform some action	On some element	On some attribute	At some place	From the current level	To the target level	Comments
9.1	Maintain	Visitor	Physical access	Mainstem	Information Need. Obtain from current GLCA and GRCA management plans. Use 10-year average distributed by season of user-days, number of people, and distribution.	Information Need	The target level should be within the capacity of the CRE to absorb visitor impacts. The target level should consider GLCA and GRCA Management Plans
			Physical safety (other than whitewater boating)		Information Need. Use average of NPS incident reports from Myers et al. for period 1988-92.[25] Include data and conclusions from other reports re: accident rates during interim and experimental flows and BHBF. Brown and Hahn (1987) did the baseline study in 1985-6 for GCES I, and collected data at medium and high flows. Jalbert and Mitchell (1992) collected data in 90-91 during the "experimental flows," primarily at low flows; and Jalbert (1997) again in 1996 during the BHBF. Also Underhill and Borkan (1987).	Metric is river-related deaths or injuries. The target is to minimize river-related injuries and deaths. Information Need: To correlate flows, equipment type, and guide experience to NPS river incident reports related to wading anglers, river travel in the flatwater reaches above the Paria River and below Separation Canyon, and trails to and along the river, to determine flow-related risk. The stage of Lake Mead should be included in the correlation for the reach below Separation Canyon.	
9.2	Maintain or improve	Recreational opportunities	Quality and quantity	Glen Canyon	Information Need GLCA data: number and variety of recreational activities.	Information Need	NPS studies underway. The target level should be within the capacity of the CRE to absorb visitor impacts. The target level should consider GLCA and GRCA Management Plans. Management action: a non-native fishing policy for concessions contracts needs to be developed.
				Grand Canyon	Information Need. GRCA data: number and variety of recreational activities.	Information Need	

Goal 9. Maintain or improve the quality of recreational experiences for users of the Colorado River ecosystem, within the framework of GCDAMP ecosystem goals.

MO #	Perform some action	On some element	On some attribute	At some place	From the current level	To the target level	Comments
9.3	Increase	Camping beaches	Size	Mainstem	Information Need From Kaplinski et al. in prep.	800 m^2 (Stewart *et al.* 2000)	The target level should be within the capacity of the CRE to absorb visitor impacts. The target level should consider GLCA and GRCA Management Plans. Metric for Quality includes parameters for vegetation, sanitation, and shade. Metric for Distribution is number of campsites required per identified reach.
			Quality	Mainstem	Information Need	Information Need Metric needs to be a "quality index." That includes parameters for open sand area, < 8 degrees slope, mooring, wind protection, ant colonies, degree of human impact (fire rings, trail erosion, litter, sanitation), vegetation encroachment, and shade. Also, need to assess and quantify the processes causing changes in beach quality and size (e.g., river flows, wind, tributary runoff, vegetation encroachment, human, other.)	
			Distribution	Critical reaches	Information Need	Minimum 21 ± 5 beaches per critical reach above maximum ROD flows (25,000 cfs) capable of accommodating 16-36 people. Also, consider NPS river travel model.	
				Non-critical reaches	Information Need	Information Need: Suggest an average of one beach capable of accommodating 16-36 people every 2.0 river miles.	

Goal 9. Maintain or improve the quality of recreational experiences for users of the Colorado River ecosystem, within the framework of GCDAMP ecosystem goals.

MO #	Perform some action	On some element	On some attribute	At some place	From the current level	To the target level	Comments
9.4	Improve	Rapids	Navigability	Mainstem	Information Need	Information Need See incident rates/flow level during the late 1980s and Interim Flow period.	The target level to be developed from NPS on-river accident rates. See Myers et al.[25] The target should address navigability across the range of flows allowed within the ROD. The metric is the number of accidents per rapid at each flow. See Brown and Hahn (1987), and Jalbert and Mitchell (1992).
			Whitewater boating safety		Information Need	Metric is river-related deaths or injuries. The target is to minimize river-related injuries and deaths. IN: To correlate flows, equipment type, and guide experience to NPS river incident reports, to determine flow-related risk.	
9.5	Maintain or enhance	Experience	Wilderness	CRE in Grand Canyon National Park	Information Need	Information Need See GRCA data on use levels and distribution.	See Bishop, *et al.* (1986) for flow-related wilderness. The target level should consider GRCA and GLCA Management Plans (in progress).
				CRE below GCD in Glen Canyon NRA	Information Need	Information Need See GLCA data on use levels and distribution.	

Goal 10. Maintain power production capacity and energy generation, and increase where feasible and advisable, within the framework of GCDAMP ecosystem goals.

MO #	Perform some action	On some element	On some attribute	At some place	From the current level	To the target level	Comments
10.1	Maintain or increase	Power	Marketable capacity and energy	GCD	Available hydropower allocations are made seasonally and vary with hydrology	Information Need	Constrained by the ROD
10.2	Maintain	Power	Existing emergency criteria for WAPA system	GCD	Emergency exception criteria	Information Need	Constrained by the ROD
10.3	Maintain	Power	Existing emergency criteria for WSCC system	GCD	Emergency exception criteria	Information Need	Constrained by the ROD
10.4	Maintain	Power	Regulation	GCD	GCD provides a share of regulation to the WALC and WACM control areas	Information Need Determine if the current regulation scheme, or additional regulation schemes, will cause problems for the ecosystem.	

Goal 11. Preserve, protect, manage, and treat cultural resources for the inspiration and benefit of past, present and future generations.

MO #	Perform some action	On some element	On some attribute	At some place	From the current level	To the target level	Comments
11.1	Preserve	Historic properties	National Register integrity	Area of Potential Effect	Information Need (at least 264 properties)	100% of historic properties	The target is to preserve National Register-eligible properties (e.g., TCPs, prehistoric, and historic sites) via protection, management, and/or treatment (e.g., data recovery) for the purpose of federal agency compliance with NHPA, as well as AMP and AMWG compliance with GCPA.
11.2	Manage	Traditionally important resources	Resource integrity	CRE	Information Need (obtained through ethnographic studies, polls, interviews, surveys, and literature)	Information Need Long-term trend indicates stable or improving for each identified resource.	The target is to manage (based on current cultural values) other traditionally important resources that are not sufficiently addressed under other MOs. Specifically, this MO addresses resources not considered Register-eligible.
11.3	Protect and maintain	Traditional cultural resources	Physical access	CRE	Information Need	Information Need	See USBR[34] The target is to provide meaningful tribal consultation on AMP activities that might restrict or block physical access by Native American traditional practitioners. See AIRFA and EO 13007.

Goal 12. Maintain a high quality monitoring, research, and adaptive management program.

12.1	Maintain or attain	Socio-economic data	Hydropower	N/A	EIS	Information Need	The target level is adequate socioeconomic data for making recommendations to the Secretary.
			Air quality	N/A	EIS	Information Need	
			Wilderness	N/A	EIS	Information Need	
			Recreation	N/A	EIS and Stewart (1999)	Information Need	
			Non-use values	N/A	Non-use study accompanying the EIS.	Information Need	
			Tribal & spiritual values	N/A	EIS	Information Need	
12.2	Integrate and synthesize	Cultural and environmental data	Interdisciplinary information	CRE	Not readily available and not completely synthesized or integrated	Readily accessible by georeferencing using GIS, databases, etc.	The target is adequate cultural and environmental data for making recommendations to the Secretary.
12.3	Attain and maintain	Monitoring and research program	Natural, cultural, and recreational resources	CRE	GCMRC Strategic Plan 1998-2002	Updated GCMRC Strategic Plan	The target is implementation of a GCMRC Strategic Plan that has been agreed to by the AMWG after review by the SAB, the PA signatories, and the TWG, and that will subsequently be reviewed on a periodic basis.

Goal 12. Maintain a high quality monitoring, research, and adaptive management program.

12.4	Attain and maintain	AMP composed of all stakeholders	That acknowledges uncertainty and uses experimentation, monitoring & research	N/A	An ongoing AMP program with a Strategic Plan in development	Updated AMP Strategic Plan	The target is implementation of an AMP Strategic Plan that describes the processes for science-based collaborative resources management.
			Participation		<u>For calendar year 2000:</u> Average TWG attendance = 92 % Average AMWG attendance = 95 % Participation on TWG and AMWG ad hoc groups = 35 % This last number was the number of TWG or AMWG members who volunteered to be on ad hoc groups divided by the total number of TWG and AMWG members.	100% attendance by all representatives at AMWG and TWG meetings plus active participation in Ad Hoc Committees.	The target is to have all AMWG and TWG members actively involved with AMP deliberations and activities, and their input recognized and valued.

Goal 12. Maintain a high quality monitoring, research, and adaptive management program.

12.5	Attain and maintain	AMP	Effective tribal consultation (i.e., inclusion of tribal values and perspectives into the AMP)	CRE	Current participation at TWG, AMWG, and PA meetings	Effective dialogue between tribes and AMWG members on all AMP actions	See USBR[32] The target is to achieve, at a minimum, effective, legally mandated government-to–government consultation. To achieve this MO it is important to provide adequate funding, but funding alone is not a sufficient indicator of successful achievement.
12.6	Attain and maintain	Management activities, research, and long-term monitoring activities	Tribal participation	AMP	Information Need	Information need	The target is a set of activities that provides meaningful tribal participation and meets each tribe's interests to ensure that tribal values are incorporated in the scientific activities of the adaptive management program, and that tribal interpretations of monitoring and research data are considered. Linkage: Vision/Mission statement, particularly the mention of federal trust responsibilities.

Goal 12. Maintain a high quality monitoring, research, and adaptive management program.

12.7	Conduct	Experimental flows	Flow dynamics	Mainstem	1996 BHBF 1997 HMF 2000 LSSF test	Information Need To be proposed by the Experimental Flows Ad Hoc Group.	See GCMRC,[6] Webb et al.[37] and Topping et al.[31] The target level is the experiments needed to gain critical understanding of ecosystem function under different dam operations, e.g., BHBFs, HMFs, biological opinion flows, and financial exception criteria flows.
12.8	Conduct	Management experiments	Other management actions	CRE	Check dams Translocation of KAS Fishing regulations	Information Need At a minimum, one management action to address native v. non-native fish interaction and one to address vegetation encroachment on beaches in the next five years.	The target level is the experiments needed to gain critical understanding of ecosystem function under different management alternatives outside of dam operations.
12.9	Build	AMP	Public support	N/A	Information Need	Information Need A public outreach plan adopted by the AMWG. Propose to have BOR, NPS, and USGS public affairs people develop the plan.	Metric should include GCMRC and BOR web pages; GCD programs and tours; AMWG Outreach Committee; publications; various AMWG member activities. The purpose is adequate public support for AMP experiments and adaptive management, and a diverse funding base.

Goal 12. Maintain a high quality monitoring, research, and adaptive management program.

12.10	Maintain or attain	Funding	Foundation and Corporate	N/A	$0	Information Need	The target is adequate funding to meet the goal. Develop a plan identifying sources for obtaining foundation and corporate funding.
			Appropriated		$75,000 (FY 2000)	$1,010,000 USGS $475,000 Tribal participation	
			State Agency		Information Need (obtain from AGFD)	Information Need	
			Power revenues		$6.22M (for GCMRC) $1.443M (for BOR)	$7,850,000 indexed for CPI	
12.11	Maintain or attain	Participation	Externally-funded investigators	CRE	Information Need (obtain from NPS)	Information Need MAs: 1. Develop a brochure that indicates support that would be provided by GCMRC and NPS to researchers who bring their own funding to address issues related to AMP MOs and INs. 2. Get outside researchers engaged and obtain their data.	Current and target levels should include small and cost-shared projects in NPS, AGFD, etc. The target is contributions to meeting Information Needs by externally funded investigators. Note: Incentives could include donated office space, partial funding, letters of support, facilitated access, and logistical support.